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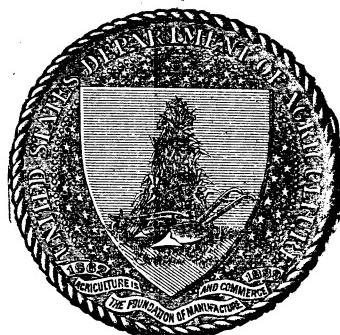
U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 82.

THE CULTURE OF TOBACCO.

BY

OTTO CARL BUTTERWECK.



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF SOILS,
Washington, D. C., June 18, 1898.

SIR: I have the honor to transmit herewith a paper on The Culture of Tobacco, prepared by Otto Carl Butterweck, of Brooksville, Fla. This paper was submitted in response to invitations sent out by the Secretary of Agriculture, and was selected from a lot of thirty papers submitted upon the same subject.

As other bulletins treating of the insect enemies and the diseases of tobacco and the whole subject of fertilization of tobacco are in course of preparation, a good deal of matter prepared by Mr. Butterweck upon these subjects has been omitted from the present bulletin.

I recommend that this be published as a Farmers' Bulletin.

Respectfully,

MILTON WHITNEY,
Chief of Division.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE CULTURE OF TOBACCO.

SELECTING THE SEED.

In the production of tobacco the proper selection of seed is one of the most important problems. Good methods, skill and experience in cultivation, careful worming, and care in the barn and after curing all amount to little if there has been any carelessness in selecting the seed.

As the different soils of the various States produce different types of tobacco, the prospective grower will have to learn from the experience of others and from the best literature he can obtain what variety of seed will likely yield the best product on the particular land to be planted. With this knowledge of what is wanted, too much care can not be exercised in obtaining the seed. It is advisable to obtain it from reliable seedsmen or from an intelligent grower rather than from a country druggist or grocery store.

Having procured the best seed for the locality and soil, the grower should maintain and improve the quality by proper selection of seed from his own crop or by the production of seed plants in other ways, as will be explained later. The production of tobacco seed requires careful attention because some varieties deteriorate while others improve in a given district. The Vuelta Abajo variety deteriorates in the States, while the Sumatra improves in flavor.

HOW MUCH SEED TO SOW.

Tobacco seeds are extremely small and an ounce of them contains from 300,000 to 400,000 seeds. A large percentage of these, however, will not sprout. Some of them are not fertile, and others have a very hard coating too resistant to moisture. On this subject Prof. S. W. Johnson, in *How Crops Grow*, says:

Among the seeds of various plants—clover, for example—which under favorable circumstances mostly germinate within one or two weeks, may often be found a number which remain unchanged, sound and dry within for months and years, though constantly wet externally. The outer coat of these seeds is exceptionally thick, dense, and resistant to moisture. * * * In a collection of such seeds kept in water individuals sprout from time to time. In case of common sorrel it was found that 10 per cent of the seed germinated between the four hundredth and five hundredth day after putting in the sprouting apparatus.

After careful experiments it is pretty well established that not more than 75 per cent of the most carefully grown tobacco seed will germinate, while very much less than this will, under ordinary circumstances, be available for planting. Allowing, however, for the imperfections in the seed, and for the too deep and too shallow planting and for loss by accident, there ought to be at least 35,000 seeds or plants from an ounce of fresh tobacco seed. It must be remembered, however, that many of these plants will be weak and some of them will be retarded by the more vigorous plants. They will not therefore be of a uniform size and ready to transplant at the same time. As the grower usually plants the field at a single planting, he can not wait for the backward plants to grow. Experienced planters therefore usually sow at least three times the amount of seed that they expect to need in order to provide themselves with sufficient plants when the time comes for setting them out. A bed 3 by 50 feet, producing from 10,000 to 20,000 plants in the aggregate, can be used for sowing about one-third of an ounce of good fresh seed, but it is safer to sow three such beds for this number of plants. By having an abundance of plants one gets the additional advantage of having a large percentage of forward, thrifty plants.

The Cuban-grown seed is generally light and chaffy. In saving seed for sale the Cubans frequently allow not only the single spike to go to seed, but the suckers. They are careless also in mixing small and light pods containing many undeveloped seed as well as those which have been injured by insects. They do not winnow the dust and hulls from the seed as well as it is done in this country. It is therefore necessary in planting imported Cuban seed to sow three times as much as of domestic seed.

Before sowing the tobacco seed it is well to test the germinating power. Sometimes the seeds are put on a hot stove, when the sterile seeds will quietly char and the vital seeds will pop. This test can not be relied upon, but a real germinating test should be made. To do this, take 100 seeds carefully counted out, place them between two wet blotters, put these between two china plates so they will remain moist, and keep in a warm place at a temperature of from 70° to 80°. The blotting papers must be kept moist, but not wet. After ten days, separate the blotting papers and count the number of seeds that have sprouted. This will give the percentage of good seed, and will be a valuable guide as to the quantity of seed to sow.

THE SEED BED AND HOW PREPARED IN THE DIFFERENT TOBACCO DISTRICTS.

In selecting a site for a seed bed there are several things that need to be considered, viz, location, exposure, protection from frosts, insects, and parasitic diseases.

A southern exposure is always best, a southeastern exposure next, then a southwestern, then a western, and lastly a northern or north-

eastern. Where possible it is advisable to locate the seed bed near a pond, lake, running brook, or river because of the moisture and greater uniformity of temperature in such a location. At the same time there is often some danger of frosts in such a locality, and in the Northern States it is necessary for this reason to make the beds on the high, warm land and supply the moisture artificially by means of watering pots.

It is best, where possible, to make the bed upon new land. There is less danger from larvæ, insects, and weed and grass seed. As damp locations are more subject to parasitic and fungous diseases, many growers prefer to make their beds for this reason on high, dry, warm soil near the house and keep it damp by frequent sprinkling. In the Southern States, as in Cuba, an open space in the woods where the midday sun shines has always been a favorite location for a seed bed because of the protection the trees afford from the cold winds and the excessive drying out of the plants and soil. The conditions are more uniform and there is less danger from frosts and insect ravages. In the Northern States the seed bed is usually made near the dwelling in the form of a cold frame with muslin over it as a protection from insects and excessive evaporation.

With the exception of the perique tobacco district in Louisiana, seed beds are burned by the most experienced growers in all localities. In the Northern States where the ground uniformly freezes to any considerable depth, the burning may be done late in the fall or in some mild spell in midwinter. In the South the land is burned over just before the seeds are sown. It is necessary to do this unless the ground has been kept thoroughly clean for several years, or unless it has been mulched the preceding year, as the ground will be so foul with weeds and grass that the young tobacco plants stand little show of surviving in the struggle for existence when vegetation begins. This burning is also a protection from grubs and insects. The object of burning is to make the ground hot enough to actually destroy the seeds of grass and weeds and to destroy the larvæ and young noxious insects which may damage the young plants.

BURNING THE BED.

Minute directions are often given about burning a seed bed, as though it were a difficult thing to do. Anyone, however, can readily burn a seed bed. Where any clearing has been done the site of a burned log heap is as good a place for a bed as can be selected.

The material at hand must determine the way in which the bed should be burned. If the material recently cleared from the land is brush, spread it in a thin layer over the ground and burn it, adding more from time to time so as to keep the heat near the ground. It is not economical to have a high pile, as much of the heat will not then be effective on the soil. If the material at hand consists of rails and logs lay down

a few rails or poles several feet apart to keep the burning wood off the ground and to admit air. Lay the wood on these poles from one to several inches apart according to circumstances. Start the fire on the leeward side so that it will burn slowly. A steady slow fire will make a better burn than a flashy quick one. The moisture in the soil to a depth of several inches must be converted into steam. This steam in forming uses up a quantity of heat. The fire must be continued long enough to steam the ground thoroughly to a depth of several inches. The upper layer of the soil to a depth of one-tenth of an inch or so will have the appearance of a burned brick when the operation has gone far enough.

PREPARATION OF THE SOIL.

After the bed has been burned and has had time to cool it should be broken with a hoe or other suitable implement to a depth of about 2 inches and the surface thoroughly pulverized. The roots and trash must be carefully raked off with a garden rake and the surface left in a level, loose, porous condition. A pound of some good commercial fertilizer or guano should be applied to each 3 square yards and thoroughly raked in.

The surface of the bed must be thoroughly pulverized and loose, so as to permit the delicate plants to grow readily, which they will not do in a lumpy soil. It also affords a good medium for the rootlets of the young tobacco plants. The bed, however, should not be worked deeply, as this would tend to prevent the moisture from rising from below and might bring to the surface seeds of grass and weeds which had been buried deeply and escaped the heat. If there is danger of washing by heavy rains it is necessary to protect the bed by shallow ditches on the sides subject to the flow of water, both to prevent the sides from being washed away or from being covered up by a deposit of sand and clay.

In the perique tobacco district of Louisiana, according to Mr. Killibrew, the making of seed beds is unlike the same work in other States. It begins in October, when cow manure is applied to a depth of 6 inches to a chosen spot in the forest and turned under with a spade. In December the bed is worked but not burned, and ditches are cut through to secure drainage. The soil is mostly humus and the beds can not, therefore, be burned.

In ordinary seasons the seed will be up in two weeks after planting. After the first leaves appear the plants seem to grow very slowly, although the roots are developing then quite rapidly. In two weeks after the plants have appeared they become more vigorous and begin to grow rapidly, especially if watered with weak liquid manures. In from six weeks to two months after the seed is sown the plants are ready for transplanting to the field.

Growers usually make it a rule to plant seed beds a week or ten days apart, as a protection against unexpected cold and other causes of loss.

When a bed is killed out with the cold it is immediately resown. When the plants are too thick in a bed they should be immediately thinned to allow space for a good root development. Each plant should be allowed at least a square inch of space for the roots to develop.

PROTECTION.

In any locality it is well to have the bed inclosed with a cold frame and covered with plant muslin. For this purpose, after burning the seed bed and before sowing the seed, inclose the bed with a frame made of 1-inch plank, 8 or 10 inches wide, placed on edge, and nailed at the corners with diagonal strips of 1 by 3 inch plank, countersunk at the corners and securely nailed for additional safety. If there are no planks available, take two poles, 4 or 5 inches in diameter, and place one on top of the other, instead of the plank. The bed may be of any desired dimensions, but it is well to have it not over 3 feet wide in order that all parts of it may be reached from either side. If there is any slope to the land a ditch should be dug on the upper side of the bed to prevent washing and the earth thrown in against the side of the bed for additional protection against washing and cold winds.

SOWING THE SEED.

As the impervious nature of the seed coat is the reason for many of the seeds not sprouting, a very simple method can be employed to obviate this trouble. Spread a newspaper on a table and lay a sheet of the finest emery paper on it. Pour a few seeds on this and with another piece of emery paper rub the seed gently. This will scratch their thick envelopes and enable them to absorb water. It is well to place the seed in a damp place for a day or two before scratching, for if they are very dry when scratched they are apt to be hulled when treated in this way. After scratching the coat, place the seed in a bowl and pour just enough water on them to cover the seed. Let them stand for forty-eight hours, by which time they will have absorbed all the water. Then mix the seed in the proportion of a quarter of an ounce of seed to 2 quarts of wood ashes, corn meal, or sterile earth and sow them carefully and evenly over the bed. Do not soak the seed unless you water in sowing. Meal or ashes are preferred to earth, because it is easy to see from the color if the sowing has been evenly done. The seed should be sowed when the wind is quiet. The seed may be sown by the thumb and fingers, or like grain, except that the hand must be held close to the bed and the sweep of the hand limited. After sowing the seed, sweep the bed over carefully with a brush, broom, or small switch, simply disturbing the surface of the bed and being careful not to bury the seed too deep.

Professor Storer, in his book entitled "Agriculture," says:

As to the methods of sowing grass seed, experience teaches very emphatically that the seed should not be buried deeply in the earth, as they do not contain a sufficient

supply of nourishment to carry the sprout through a considerable layer of earth, and there is great danger of losing them if they are deeply covered. It is true, in general, that wherever seeds can be kept properly moistened they should not be deeply buried, and this both because the seed need air and because of the risk of placing too many impediments in the way of the young shoot. The distance through which the young shoot must pass in order to get above ground should be as short as possible, in order that the store of nourishment in the seed may not be wholly exhausted in the struggle with the layer of earth above the seed. Some of this store of nourishment is wanted to establish the plant firmly after it has reached the air. With timothy seed, for example, a German experimenter, Jensen, found that less than half the number of seed sown an inch deep came up either in loam or sand, while the whole of the seed grew that was sown 0.06 of an inch deep.

The importance, then, of covering the tobacco seed very little will be appreciated when it is remembered that tobacco seed is very much smaller than timothy seed:

After the seed has been sown and brushed in, it should be thoroughly sprinkled to firm the earth. This is the best practice. It may be firmed by carefully tamping with a spade or hoe, or by laying down a board and standing upon it, turning the board over and repeating until the whole bed has been gone over. It may be tamped with square boards, 8 by 10 inches, secured to the feet with straps. The writer is convinced, however, that the firming is best done by simply thoroughly sprinkling and keeping the bed continuously moist. The sprinkling should be repeated twice a week, or even oftener if necessary, and daily in very dry weather. The beds should be kept covered with canvas or cloth fastened on the side of the frame by means of headless wire nails driven in such a manner as to hold the cloth; or the covering may be fastened to small poles or inch strips a few inches longer than the length of the bed and placed 2 feet apart with the cloth fastened to them. Such a covering can be readily rolled up and stored away, and will last several seasons. A bed so covered will be protected from the depredations of insects of all kinds—a constant source of annoyance and loss in open beds. Moisture, also, will be conserved, and both the humidity and temperature of the air will be more uniform. A week or two before transplanting the covering should be removed about one-half hour after sunrise for an hour or two and the time of exposure increased from day to day until two or three days before planting, when the covering should be left off altogether to harden the plants and give them the necessary vigor to stand the shock of transplanting.

TIME OF SOWING SEED.

There seems to be a general rule for sowing the seed in each State with reference to the frosts which are likely to occur in the spring. The following table, furnished by the Weather Bureau, will be a basis for a more intelligent rule for sowing the seed. Seed beds should be planted from six weeks to two months, according to the variety of the seed, before the latest date at which killing frost has occurred in the

locality. This is for domestic seed. For imported Cuban and Sumatra seed a later date should be selected. Imported Cuban seed should be planted a month later and imported Sumatra six weeks later than acclimated seed. Very vigorous varieties of tobacco will grow large enough to transplant in six weeks; other varieties will take from eight to ten weeks from the time of sowing the seed.

The following table gives the average and latest dates at which killing frosts occur in the spring, as furnished by the Weather Bureau:

Average and actual date of last killing frost in the spring and earliest killing frost in the fall.

[From records of the United States Weather Bureau.]

State and locality.	Spring.		Fall.
	Average.	Last.	Earliest.
Alabama:			
Mobile	Feb. 24	Apr. 6	Nov. 2
Montgomery	Mar. 10	...do...	Oct. 21
Arkansas:			
Little Rock	Mar. 21	Apr. 14	Oct. 8
Fort Smith	Mar. 22	Apr. 6	Oct. 7
Colorado:			
Denver.....	May 25	June 6	Sept. 10
Connecticut:			
New Haven	May 30	May 30	Sept. 15
District of Columbia:			
Washington.....	Apr. 4	Apr. 29	Oct. 4
Florida:			
Cedar Key	Feb. 4	Mar. 12	Nov. 25
Jacksonville	Feb. 24	Mar. 27	Nov. 12
Pensacola	Mar. 7	Apr. 6	Do.
Georgia:			
Atlanta	Mar. 25	May 21	Oct. 16
Augusta	Mar. 17	Apr. 5	Oct. 8
Savannah	Mar. 1	...do...	Nov. 2
Illinois:			
Cairo	Mar. 31	May 8	Oct. 2
Chicago	Apr. 23	May 25	Sept. 27
Springfield	Apr. 16	...do...	Sept. 13
Indiana:			
Indianapolis	Apr. 17	May 21	Sept. 26
Iowa:			
Davenport	Apr. 25	May 22	Sept. 13
Des Moines.....	Apr. 24	May 31	Sept. 12
Dubuque	Apr. 27	May 23	Sept. 5
Keokuk	Apr. 10	May 2	Sept. 18
Kansas:			
Dodge City	Apr. 22	May 23	Sept. 23
Leavenworth	Apr. 6	May 21	Sept. 13
Kentucky:			
Louisville	Apr. 8	May 15	Sept. 30
Louisiana:			
New Orleans	Feb. 2	Mar. 27	Nov. 11
Shreveport	Feb. 26	Mar. 31	Oct. 13
Maine:			
Portsmouth	Apr. 14	May 5	Sept. 7
Maryland:			
Baltimore	Apr. 6	May 3	Oct. 6
Massachusetts:			
Boston		May 17	Sept. 30
Michigan:			
Alpena	May 10	June 29	Aug. 24
Detroit	May 2	May 28	Sept. 23
Escanaba	May 13	May 29	Sept. 1
Grand Haven	May 30	May 28	Aug. 21
Marquette	May 18	June 11	Aug. 22
Port Huron	May 2	June 6	Sept. 14
Minnesota:			
St. Paul	May 1	May 25	Sept. 1
Duluth	May 6	June 8	Sept. 13
Moorhead	May 18	June 5	Aug. 25
Mississippi:			
Vicksburg	Mar. 3	Apr. 22	Oct. 19
Missouri:			
St. Louis	Mar. 31	May 2	Oct. 14

Average and actual date of last killing frost in the spring and earliest killing frost in the fall—Continued.

[From records of the United States Weather Bureau.]

State and locality.	Spring.		Fall.
	Average.	Last.	Earliest.
Nebraska:			
Omaha.....	Apr. 15	.....	Sept. 20
North Platte.....	May 1	.....	Sept. 10
New Jersey:			
Atlantic City.....	Apr. 6	Apr. 23	Oct. 4
Cape May.....	do	May 3	Oct. 29
New Mexico:			
Santa Fe.....	Apr. 22	May 22	Sept. 19
New York:			
Albany.....	Apr. 21	do	Oct. 15
Buffalo.....	May 27	May 29	Sept. 21
New York.....	Apr. 14	Apr. 25	Oct. 15
Oswego.....	Apr. 26	May 29	Sept. 26
Rochester.....	May 3	do	Do.
North Carolina:			
Charlotte.....	Apr. 1	May 3	Oct. 8
Hatteras.....	Feb. 27	Apr. 5	Nov. 22
Manteo.....	Mar. 14	Apr. 19	Oct. 16
Wilmington.....	Mar. 15	Apr. 20	Oct. 13
North Dakota:			
Bismarck.....	June 6	.....
St. Vincent.....	June 8	.....	Aug. 4
Ohio:			
Cincinnati.....	Apr. 15	May 22	Sept. 30
Cleveland.....	Apr. 26	June 6	Sept. 24
Columbus.....	Apr. 18	May 17	Sept. 29
Sandusky.....	Apr. 9	May 23	Oct. 8
Toledo.....	Apr. 24	do	Sept. 9
Oklahoma:			
Fort Sill.....	Mar. 15	Apr. 13	Oct. 1
Pennsylvania:			
Erie.....	Apr. 25	May 29	Sept. 16
Philadelphia.....	Apr. 5	Apr. 29	Oct. 2
Pittsburg.....	Apr. 27	May 22	Sept. 25
South Carolina:			
Charleston.....	Feb. 24	Apr. 2	Nov. 8
South Dakota:			
Deadwood.....	May 11	May 31	Sept. 7
Huron.....	May 14	June 22	Sept. 3
Yankton.....	Apr. 28	May 23	Sept. 13
Tennessee:			
Chattanooga.....	Mar. 23	Apr. 24	Sept. 30
Knoxville.....	Apr. 6	Apr. 25	Oct. 8
Memphis.....	Mar. 24	Apr. 21	Oct. 2
Nashville.....	Mar. 31	May 24	Oct. 8
Texas:			
Abilene.....	Mar. 14	Mar. 29	Oct. 22
Brownsville.....	Jan. 24	Mar. 1	Dec. 5
El Paso.....	Mar. 27	Apr. 22	Oct. 24
Galveston.....	Feb. 2	Mar. 18	Nov. 18
Palestine.....	.....	Mar. 30	Nov. 10
Virginia:			
Lynchburg.....	Apr. 11	May 7	Oct. 3
Norfolk.....	Mar. 26	Apr. 26	Oct. 10
Wisconsin:			
La Crosse.....	May 1	May 23	Sept. 21
Milwaukee.....	Apr. 30	May 28	Sept. 17

Transplanting should be done as soon as possible after the date on which the last killing frost has occurred in the locality and should be completed within a month. It is frequently advisable to plant earlier than the date of the last killing frost and take the chance of the crop being caught. This, however, should be an exception. Early planting, to be sure, saves much labor in worming, and where air curing is practiced the benefit of the warm weather for the barn curing is quite an advantage. On the other hand, many prefer to plant as late as the season permits, because the warm sun of summer is believed to produce a sweeter product.

As a rule, early planting secures the benefit of the winter and spring rains and secures comparative freedom from insects, with the exception of the cut-worm. Where the transplanting is done late in the season there is more danger from drought and a greater risk of obtaining a poor stand. Of course where irrigation is practiced tobacco can be planted at a later date, provided it will mature during the growing season. Generally speaking, in localities south of the twenty-eighth degree of latitude, transplanting is done in February and March; in Louisiana from March 15 to April 15; Tennessee, May 1 to 20; Kentucky, about May 20; eastern Georgia, about April 10; western Georgia, May 1; South Carolina, April 10; North Carolina, May 1; Virginia, May 10; Pennsylvania, New York, New England, and Wisconsin, June 1 to 20.

It will be seen by comparing these dates with the schedule of the latest killing frosts that have occurred in their respective districts that experience has demonstrated that the best time to transplant tobacco plants is as early as possible after the date of the last killing frost that has occurred in the locality.

Before leaving this subject it will be well to call attention to the information in the third column of the table just given, which gives the date of the earliest autumn frost in the several tobacco seasons and marks what should be the end of the tobacco-growing season. Tobacco is very easily injured by frosts and it should be housed by the time the first killing frost is liable to occur in the autumn. It is easy, therefore, to calculate from this table the season in which the crop has to develop and mature. It must be remembered, however, that the occurrence of the first killing frost of the autumn varies considerably from year to year, and the average date is from one to four weeks later than the earliest date in most of the localities given in the table.

PLANTING.

The field selected for the tobacco should be plowed in the fall. This will tend to bring it into good tilth and will help to destroy larvæ of all kinds which may be destructive to the crop when it is young. In localities where the ground freezes it is well to plow in the fall for the purpose of destroying the cutworms. At the fall plowing it is well also to apply all rough manures which need time for rotting. In the spring the land is plowed again as early as possible, and the fertilizers are then applied and harrowed in. Two or three weeks before planting the land is again harrowed and laid off in rows either by throwing a furrow each way with a turning plow or with a ridger. The distance apart varies somewhat in the different localities, but a general rule is from 3 to $3\frac{1}{2}$ feet apart each way. Sometimes the land is checked 3 by 4 feet, in order that the cultivation may be continued longer. In this case, if in the North, the wide furrows should run north and south for

additional sunlight for the crop. With Sumatra tobacco, as grown in the South, 4 feet are allowed between the rows.

In the Northern States sunlight is sought after, while in Florida and Cuba shade is desired. Tobacco raised in an orange grove in Cuba always brings a better price than tobacco raised in the open field. In Florida open lattice sheds, with strips 3 inches wide and 3 inches apart overhead, are provided to shade the tobacco field. This method is growing in popularity.

For the smaller and finer varieties of manufacturing tobacco the checks may be 3 feet or 3 feet 3 inches square. In Sumatra, where the coolie does all the labor by hand, the rows are made 2 feet apart, and the plants stand 2 feet apart in the row. In Cuba and in southern Florida, where hand cultivation is still largely practiced, the rows are made 2 feet 6 inches apart, and the plants are set from 12 to 18 inches apart in the row, according to the strength of the soil and the amount of guano applied. Such close planting as this could not, of course, be adopted where horse cultivation is practiced, as in the Northern States.

The plants are set out when they are from 4 to 6 inches high in the seed bed. This is an invariable rule in all the tobacco districts of this country; but in Cuba they are allowed to grow much larger, even as much as 8 or 10 inches high. In drawing the plants the seed bed is thoroughly watered, so that it will be loose and will not tear the roots much in drawing the plants. It is also advisable to have as much of the soil adhere to the roots when taken up as possible. The drawing should be done in the early morning while the dew is on the plants, as the leaves are less liable to be injured. The plant should be grasped in one hand between the thumb and finger and gently lifted by means of a fork or small pointed stick to prevent as much as possible injury to the stem and roots and to bring up some of the dirt adhering to the roots. The plants are then put in baskets or small boxes, the roots together. The package is then covered with a damp cloth and placed in a shady, cool place until it is time to set out the plants.

In the early spring, especially when the day is cloudy and damp just after a rain, plants may be set out at any time in the day. Later in the season, however, as the air becomes drier and the temperature higher, plants are usually set out after noon. The later the season the later the time of setting out. Also the more southern the locality or the higher the temperature the later in the day the plants should be set out.

There are two methods of planting, either by hand or by the use of a planter. In hand planting the plants are dropped at regular intervals, usually by boys, girls, or women, while another hand follows with a dibble made of a round stick $1\frac{1}{4}$ inches in diameter and 10 inches long. With this he makes a hole into which he inserts the roots of the plant, holding the plant firmly with the leaves between the thumb and finger. The dirt is then pressed around the roots with the dibble to firm the soil, and then loose earth is brought up around the plant and

the whole surface left in as loose a condition as possible. Sometimes the holes are made with a staff—that is, a smooth, round stick about $1\frac{1}{2}$ inches in diameter and 4 feet long, sharpened at one end. A hand takes the staff and makes the holes with a brisk jab the desired distance apart as he walks along; another follows with a basket of plants, the plants being dropped near the holes; another follows and sets the plants in the holes. The plants should be so firmly imbedded that they can not readily be pulled up by pulling on the top of one of the leaves.

WATERING.

If the soil is damp when the plants are set they will grow without water. If, however, the soil is dry when the plants are put out watering will have to be done immediately before planting. To do this a hand precedes the planter with a pail of water and a dipper and fills the holes with water just before the plant is set in. If the season continues dry the plants may need watering until they establish themselves, which is usually about a week from the time of setting out. In this case it is better to make a hole near the plant with the dibble and put the water in that and cover it over with loose dry soil to prevent evaporation than to apply the water directly to the surface. Where possible it is, of course, very much better and very much cheaper to wait for the spring rains to moisten the ground and get it in order for planting.

On large plantations in Cuba no holes are made to set plants in. They "bust out the middle of the row" with a scooter or shovel and set plants in the furrow. The plants are set so that the bud will come just above the level of the field. The furrows are freshly made as the planting proceeds, so that the soil shall not dry out too much for planting. The plants are usually longer than in this country, and if they are of extra length they are planted in a sloping position or are bent in the furrow so that the bud only will be above the level of the field. After planting the rows are leveled with a hoe. Replanting is done where necessary, but otherwise the soil is not disturbed for about two weeks, or until the plants become established. After that the field is continuously worked and is kept like a garden. The Cubans claim that with a setting of larger plants less loss occurs than with smaller ones. The writer has tried this furrow system and has no hesitation in recommending it to tobacco planters. It is more speedy to set the plants in rows and there is no reason why it should not be practiced in check fields.

The method of transplanting with machines is now very generally practiced in the Northern cigar-tobacco States. There are a number of machines designed for this purpose upon the market. The machine is usually drawn by two horses and carries the driver and two other persons to throw in the plants. The machine waters the holes uni-

formly before planting, sets the plant, and firms the earth uniformly and firmly around it. It is claimed that machine-set plants usually grow off better than hand-set ones and a better stand is obtained. Where the transplanter is used the field must be in excellent tilth and free from stumps, rocks, and litter. By its use a man and two boys can set from 2 to 6 acres per day, and as the soil is watered immediately before setting it is not necessary to wait for a wet season.

CULTIVATION.

A tobacco field should be kept clean and in good tilth, both to promote the growth of the plant and, by removing grass, weeds, and trash, to lessen the harbors for insects of all kinds. In ten days or two weeks after the plants have been set out, hoe between them, removing the dry dirt and drawing fresh moist earth to them. They should then be cultivated with a shallow instrument, such as a cultivator or a sweep, throwing a little earth to the plant. The cultivation should be shallow. Do not cut or disturb the roots of the tobacco plant, as it checks its growth and tends to make a fibrous, woody leaf. A rapid growth from the time of setting until the plant matures gives a finer textured leaf than a slow growth. Still, for some varieties of tobacco and for certain purposes it is not desired to have a fine texture of leaf. No rigid rule can be laid down as to the frequency of cultivation. Judgment must be used in this as in other matters of farm practice. As a rule, fields should be cultivated after every rain, as soon as the soil is in condition to work. The surface should be stirred after the rain, both to admit air and to prevent excessive evaporation.

When the plants get of large size and begin to throw out buds they will be too large for horse cultivation. The field should then be kept clean from weeds and grass with a hoe. Dr. Goessman, of the experiment station at Amherst, Mass., says "the timely shallow use of the cultivator or the hoe for the removal of weeds favors a uniform progress and growth. The careless use of the cultivator or hoe invariably checks more or less the growth of the plants and modifies more or less strikingly the general character." In cultivating, always work the soil to the plant. It is better to pull up a few weeds and bunches of grass near the plant than to use a tool, because of the danger of injuring the roots.

FERTILIZERS.

In fertilizing the tobacco plant there is need to consider both the yield of the crop as a whole and the effect of certain fertilizers upon the quality of the finished leaf. There are certain substances which can not be used without injuriously affecting the burning qualities of the leaf. Chlorine, which is contained in common salt, muriate of potash, kainite, and generally in the lower and cheaper forms of potash

salts, is decidedly injurious to the burning qualities of tobacco. Sulphate of potash, when used in excess, is generally believed to be injurious to the burning qualities of the cigar leaf. Excess of phosphoric acid is injurious, as it affects the color of the ash. According to Nessler's observations, the more phosphoric acid there is in a soil the more of it is taken up by the tobacco plant. Excess of nitrogen, especially that in the form of raw animal fertilizers and fresh animal manure, makes a coarse, thick leaf which is unfavorable for the wrapper types, but is quite favorable to some of the manufacturing and export types.

As a rule, care must be taken in the production of cigar-wrapper leaf and in the bright yellow leaf of Virginia and North Carolina to use only moderate quantities of stable manure or animal nitrogenous manures of any kind, as it is not desired that the leaf should be thick and coarse. With the heavy export types great quantities of these manures may be used to advantage. Large quantities of mineral manures are used in the production of both the wrapper leaf for cigars and the bright yellow tobacco, as these are both grown on very poor sandy soils which depend mainly for their food supply upon the minerals applied.

Dr. Goessman summarizes the results of the field experiments with the cigar tobacco in Massachusetts in Bulletin No. 47 of the Massachusetts Experiment Station, as follows:

Cotton-seed meal and castor pumice have proved quite good sources of nitrogen for the successful raising of tobacco when used in connection with nitrate of soda or potash sufficient to furnish one-fourth of the nitrogen called for by the crop. Cotton-seed hull ashes and high-grade sulphate of potash have proved, in our observation, most valuable sources of potash for tobacco. Acid phosphate and phosphatic slag are used in preference to animal phosphates. The standard fertilizer, recommended by the station, was phosphate, 3 per cent, nitrogen, 5 per cent, and potash, 15 per cent. There have been so many conflicting claims made as the result of careful experiments in different localities that it is evident that the nature of the soil, the character of the season, and other factors which are not known at present have so much influence that no precise statement can be made of the best fertilizers for tobacco.

From 200 pounds to a ton of commercial fertilizers are commonly applied per acre to the tobacco crop. Sometimes as much as 2 tons are used where a high-grade wrapper leaf or thin, bright tobacco can be produced. The fertilizer may be either broadcasted or drilled in the row just before the plants are set out. Sometimes the fertilizer is applied in two or three applications during the season.

TOPPING.

The objective point in the life of a plant is the production of seed for the perpetuation of the species. When the seed head forms and develops, the nourishment is gradually transferred from the leaves and used for the formation and production of seed. In a plant like tobacco, which is valued for the quality of the leaf, it is necessary to remove

the seed head as it forms, in order that the nutritive substance may remain in the leaf. When the bud is removed the plant throws out suckers at the junction of the leaves, and these also must be promptly removed or the leaf will lose part of the nutritive matter which has been stored up in it.

Just when is the proper time to top is a disputed question. It depends upon the variety of the plant, the vigor of growth, and the conditions of soil and climate, as well as upon the use for which the tobacco is intended. To retain the greatest amount of nutritive matter in the leaves and to induce a uniform ripening of the plant, the bloom bud should be removed as soon as it appears.

Just how much of the top should be removed in taking out the bud also depends upon the variety of tobacco and upon the strength and vitality of the plant. Strong, vigorous plants are topped high. When a good stand is obtained at planting, the plants will bud about the same time, but all the plants of a field will not be ready to top at the same time, and a great deal of judgment is required to know when to remove the bud. This judgment is based upon the vitality of the plant and for what purpose the leaves are to be grown. It is necessary, therefore, to go over the field several times to remove the buds, and after the first time the suckers are removed at the same time the buds are taken out. It must not be understood that suckering is not necessary before this time. Some plants send out suckers at an early period of their life, long before the bloom bud appears, and these suckers must be removed as they appear.

In the cigar-tobacco districts from 15 to 20 leaves are left on the plant. When the tobacco is intended mainly for cigar fillers a less number are left on, as it is desired to have the leaves stronger than where wrappers are produced. On the heavier types of manufacturing and export tobaccos from 10 to 12 leaves are left on. More are left on very vigorous plants than on delicate ones. Experienced toppers do not count the leaves, but use their judgment as to the ability of the plant to maintain a certain number which they think should be left on. The suckers have to be removed two or three times during the season.

In Cuba and in Florida a good, vigorous sucker is allowed to remain when the plant is cut, and this develops into what is called a sucker crop, which is somewhat inferior to the first crop, but is good for filler purposes.

CUTTING.

"The passage of the various constituents of a plant from one part of it to another, as the plant advances to maturity, is a capital fact common to all plants, and we see in fact that the oldest leaves gradually wither and die as they give up to the newer parts of the plant many of the matters that were contained in their cells. There comes a time when the plant ceases to draw food from the air and from the soil and

devotes itself to the purpose of concentrating the nourishment that was previously scattered through all its parts." At this period the leaves begin to change color, light yellow spots appear upon them, and the leaf or plant is said to be ripe and ready to be cut. As the leaves ripen from the bottom upward, the rational system is to pick or prime the tobacco as the leaves ripen. This is done in the bright-tobacco district and to some extent in the cigar districts of Florida. In the other districts, including the cigar districts of the North and manufacturing and export tobacco districts, the plant is cut when the middle leaves are about ripe. If the plant is not fully matured at the time of cutting it is liable to cure dark, or if the weather happens to be dry or cold, so that it dries out quickly, it will cure green and be worthless.

The time when a plant is ripe and ready to be cut is a matter of judgment and experience. There is a slight change in the color of the leaf, perceptible in looking over a field of tobacco, which shows the experienced grower that it is ready to be cut. When the leaf is observed to change color from a rank green to a lighter shade of green, and yellow spots appear, it is a certain indication that the constituents of the leaf have performed their duty and are going back to the stalk to be carried to the upper leaves or to be used for other purposes in the economy of the plant.

Another test of this is to fold the leaf between the fingers, and if the leaf snaps or retains a crease where it was folded it is said to be ripe.

A plant that is topped low, with only 8 or 10 leaves, will mature more uniformly, of course, than one that is topped high, like the Sumatra, where 18 or 20 leaves are left on the plant.

Cutting or priming should not be done when dew or rain is on the plant, as it is liable to leave black spots on the cured leaf. In the South cutting is not done until afternoon in midsummer, as the midday sun is liable to sunburn the tobacco in a few moments.

Where priming is done the leaves are placed in baskets or shallow boxes to be carried to the drying sheds, where they are strung on twine or on wires. The leaves are put face to face and back to back, 30 to 50 to a string, according to the size of the leaf. The twine or wire is then stretched on a 4-foot lath with a slit about 2 inches long sawed in each end, and hung in its place in the barn. In harvesting plants they will not all be ready to be cut at the same time, and it is necessary to go over the field a number of times, and cut them only as they ripen.

Where the whole plant is cut it is allowed to wilt for several hours before being carried to the barn to prevent breaking the turgid leaves. Plants are cut and laid in rows on the ground to wilt, several rows being laid in one for convenience in handling. With the finer grades of cigar wrapper the plant is not allowed to lie on the ground directly, and in many localities the wilting is done after the plant is put on laths, upon which it is to be hung in the barn, and the laths supported

on small trestles in the field or in racks arranged for the purpose. When sufficiently wilted the tobacco is hauled to the barn, either on racks made for the purpose or carefully piled on the wagon bed. In hanging the tobacco the butts are either pierced with an iron-pointed lath, or the stalk is split all the way up and the plants strung on the laths in this way. Before being hung up care should be taken to remove all worms and eggs from the leaves, as the latter are liable to hatch and the worms do great injury to the leaves while hanging in the barn. All the suckers should also be removed, or they will continue to grow and absorb the nourishment of the full-grown leaves.

In Cuba and southern Florida the plant is cut in sections in the field. The three top leaves, usually the finest wrappers, are cut in one section, the rest of the stalk is cut in sections of two each. Two rows are taken at a time, and the sections are assorted according to their grade and position on the plant. The field is gone over several times until all the ripe plants have been cut. Boys accompany the experts and receive the sections on their arms, the stems being turned alternately to prevent the loads from falling. When a turn has been received the boys slide the sections on to poles placed on forked stakes at convenient places in the field. These poles when full are carried to the barn. The Cubans use long poles, usually 13 feet in length. This system has the advantage of sorting the tobacco as it goes into the barn. As the curing progresses in the barn the leaves are separated more and more for a better circulation of air.

Cut tobacco must not be left exposed to the sun and wind, especially when lying on the ground in small piles. It must be hauled to the wilting sheds or barns as soon as the leaves are sufficiently wilted to avoid being broken in handling.

Where priming is practiced the leaves should be left to mature further than where the entire stalk is cut, for while the stalk is hanging in the barn a translocation of the matters from the stalk to the leaves takes place and from the leaf to the stalk, and the leaf ages and matures, therefore, while hanging in the barn. When the leaf is once severed from the stalk, however, in the process of priming or cutting in sections, there is no opportunity for this transfer except to the very small portion of stalk which is left on the section.

SAVING SEED.

The grower should maintain and even improve the quality of his crop by a judicious selection of seed plants. To this end the field is gone over several times during the growing season and typical plants picked out possessing the greatest possible number of good points. After finally deciding upon the plants which should be saved for seed, these are allowed to grow to full maturity without removing the seed head when the rest of the field is topped. As the seeds of a plant are pro-

duced from the food material prepared in the leaves, the leaves should be left upon the seed plant until the seed is ripe. It is advisable also to have plants close together in order that they may fertilize each other by the exchange of their pollen. Only the central spike of the plant should be left for seed, the suckers being removed as they develop in order that all the nourishment taken up by the plant should go into the central spike to make heavy seed.

The largest pods will contain the heaviest seed, and these should be selected for planting. "Hellriegel found that the weight of the seed sown had under some circumstances considerable influence on the yield of the crop, and that the young plants from the over ripe seed were decidedly the strongest and most vigorous, the others being smaller and feebler, very much in proportion as the seed from which they grew had been gathered earlier." The heavier seeds can be separated from the light by winnowing in a light wind or by screening. Seed plants of different varieties should be separated as far as possible to prevent crossing through the intervention of insects, air currents, etc. Exchanging and mixing seed of the same variety grown some miles distant is good practice, as it tends to make the seed and plants more vigorous.

A great deal of trouble arises in attempting to maintain a fair strain of tobacco seed on account of the facility with which cross fertilization occurs in the field. For this reason the recent experiments of Dr. Doroxie, editor of the "Hungarian Tobacco Gazette" of Budapest, mentioned by Killebrew and Myrick in "Tobacco Leaf," is of great interest. This gentleman "has propagated tobacco from slips, and claims that the leaves harvested from such propagated plants are finer and of higher quality than those of the mother plant."

The suckers from the plant are easily propagated in a suitable seed bed, just as slips of any of the ordinary flower plants, such as geranium or coleus. They can be readily grown to maturity in the field or in the hothouse, and the seeds so obtained will actually represent the parent without change from cross fertilization from other plants if care is taken.

It seems probable that by continuously raising seed from suckers instead of from seed, Havana or other superior kinds of tobacco can be acclimated in the Northern States and retain the qualities of the first year's crop, just as original qualities are retained by layering and grafting fruit.

Tobacco seed will retain its vitality for ten or twenty years, but it must be remembered that as a general rule all seeds begin to lose their vitality from the moment of ripeness. The process of deterioration with tobacco seed goes on, and on each succeeding year a less number of seeds will sprout until finally all lose their germinating power. In planting old seed they should be first tested and the quantity sown should be proportional to the vitality of the seed.

INSECT PESTS.

Trouble with insects begins from the moment the seed is sown and continues even after the tobacco is harvested and hung in the curing shed. Ants in the seed bed, cut-worms at the planting of the crop, and tobacco worms throughout the growing season of the plant have to be continuously sought for and destroyed. For cut-worms it is best to spread over the field before planting cabbage or turnip leaves, bunches of grass, or meal dipped in a solution of paris green, a tablespoonful of paris green to a bucket of water. Where the meal is used, one tablespoonful of paris green should be mixed with a gallon of meal or flour. Two such applications are recommended. After the plants are set it is also well to dust them with a mixture of paris green and meal.

There are several remedies proposed for the destruction of the tobacco worm, but the most satisfactory, although the most expensive method, is to search for them in the early morning and destroy them by hand. During the heat of the day they retire into sheltered places where it is not easy to find them. At the same time in looking for the worms, the eggs of the moth should be destroyed wherever seen on the leaves. These eggs are about the size of a tobacco seed and are nearly the color of the leaf itself, so that they are hard to find. Attempts have been made to catch the moth in various kinds of traps, and considerable relief has been secured thereby. The field should be gone over at least three times a week. It is especially desirable to destroy as completely as possible the earlier brood, so that there will not be so many later in the season when the main brood comes on.



FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

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- No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24.
- No. 18. Forage Plants for the South. Pp. 30.
- No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 20.
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- No. 60. Methods of Curing Tobacco. Pp. 16.
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